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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/578,912	05/09/2006	Keiichirou Kai	1034232-000038	4449

21839 7590 06/30/2011

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POST OFFICE BOX 1404
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EXAMINER	
BLAND, LAYLA D	
ART UNIT	PAPER NUMBER
1623	

NOTIFICATION DATE	DELIVERY MODE
06/30/2011	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte KEIICHIROU KAI, HITOKI MIYAKE,
and TOSHIHIRO OIKAWA

———————

Appeal 2011-000481
Application 10/578,912
Technology Center 1600

———————

Before TONI R. SCHEINER, ERIC GRIMES, and
MELANIE L. McCOLLUM, Administrative Patent Judges.

GRIMES, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 involving claims to a process for producing a pentose-5-phosphate ester. The Examiner has rejected the claims as obvious. We have jurisdiction under 35 U.S.C. § 6(b). We affirm.

STATEMENT OF THE CASE

Claims 1, 4, and 6 are on appeal. The claims have not been argued separately and therefore stand or fall together. 37 C.F.R. § 41.37(c)(1)(vii). Claim 1 is representative and reads as follows:

1. A process for producing a pentose-5-phosphate ester, wherein:
a pentose is reacted with a phosphoric acid donor in the presence of an acid phosphatase;
the pentose is a pentose in (3S, 4R) or (3R, 4S) and the pentose is ribose, arabinose or 2-deoxyribose;
the pentose-5-phosphate ester is a pentose-5-phosphate ester in (3S, 4R) or (3R, 4S) and the pentose-5-phosphate ester is a ribose-5-phosphate ester, an arabinose-5-phosphate ester or a 2-deoxyribose-5-phosphate ester;
the acid phosphatase is an acid phosphatase derived from Shigella flexneri, and
the pentose is reacted with the phosphoric acid donor at a molar ratio of not less than 3 fold and not more than 7 fold phosphoric acid donor to pentose.

Issue

The Examiner has rejected claims 1, 4 and 6 under 35 U.S.C. § 103(a) as being obvious in view of Tanaka,[1] Asano,[2] and Gross.[3] The Examiner finds that Tanaka discloses "the phosphorylation of inosine to inosine-5'-monophosphate by nonspecific acid phosphatases from Shigella flexneri ... [as well as] the phosphorylation of glucose to glucose-6-phosphate" (Answer 4) but does not teach phosphorylation of a free pentose (id. at 5). The Examiner finds, however, that it would have been reasonable to expect Tanaka's enzyme to phosphorylate the substrates recited in the claims because Tanaka discloses that "the enzyme is nonspecific" (id. at 6) and "the

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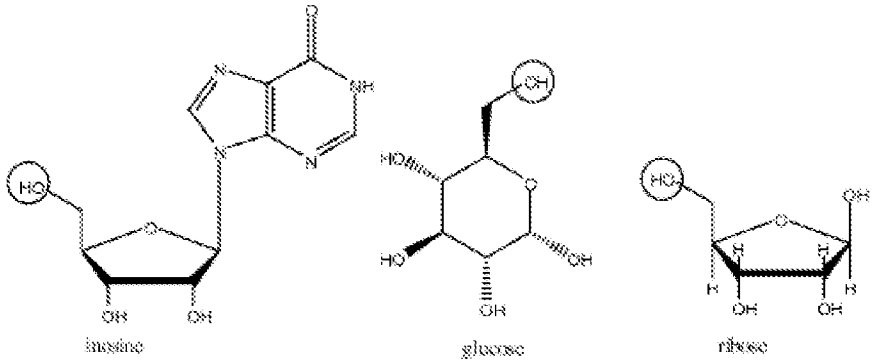
[1] Tanaka et al., Phosphorylation and dephosphorylation of polyhydroxy compounds by class A bacterial acid phosphatases, 1 ORG. BIOMOL. CHEM. 2833-2839 (2003).
[2] Asano et al., A new enzymatic method of selective phosphorylation of nucleosides, 6 J. MOL. CATALYSIS B: ENZYMATIC 271-277 (1999).
[3] Gross et al., Practical Synthesis of 5-Phospho-D-*ribosyl* α-1-Pyrophosphate (PRPP): Enzymatic Routes from Ribose 5-Phosphate or Ribose, 105 J. AM. CHEM. SOC. 7428-7435 (1983).

structure of a pentose such as ribose is very similar to the structures of inosine and glucose with respect to the reaction sites," providing the following diagram for illustration:



(Id.).

The Examiner concludes that it would have been obvious to "prepare a pentose-5-phosphate ester using acid phosphatase from Shigella flexneri in the presence of pyrophosphate" (id. at 5) because Tanaka supports a reasonable expectation that the enzyme would act on a pentose substrate and Gross discloses that "ribose 5-phosphate is an intermediate in the synthesis of nucleotides, histadine [sic] and tryptophan" (id.), and therefore "such compounds are useful intermediates" (id. at 6).

Appellants contend that nothing in the cited references guides "one of ordinary skill in the art towards using the claimed enzyme with the claimed substrates, as opposed to the countless numbers of other potential candidate substrates" (Appeal Br. 4). Appellants also contend that one of ordinary skill in the art would not have had a reasonable basis for expecting that a Shigella flexneri acid phosphatase would phosphorylate one of the pentose substrates recited in the claims (id. at 5-6).

The issue presented is: Does the evidence of record support the Examiner's conclusion that one of ordinary skill in the art, based on the cited references, would have reasonably expected a Shigella flexneri acid phosphatase to phosphorylate one of the recited pentose substrates?

Findings of Fact

1. Tanaka discloses that "[n]onspecific acid phosphatases (NSAPs) are bacterial enzymes which are able to catalyse the hydrolysis of phosphate monoesters" (Tanaka 2833, left col.).

2. Tanaka discloses a study of "the kinetics of the phosphorylation of glucose and dephosphorylation of glucose-6-phosphate (G6P) catalysed by the acid phosphatases from Shigella flexneri (PhoN-Sf) and Salmonella enterica (PhoN-Se)" (id., abstract).

3. Tanaka discloses that the acid phosphatase from Shigella flexneri (PhoN-Sf) is a nonspecific acid phosphatase (id. at 2833, right col.).

4. Tanaka discloses that "PhoN-Sf is able to phosphorylate glucose regiospecifically to G6P, glucose-1-phosphate is not formed" (id., abstract).

5. Tanaka discloses that "PhoN-Sf regiospecifically phosphorylates inosine to inosine-5'-monophosphate" (id.).

6. Tanaka discloses that "[c]onsidering the nature of the substrates that are phosphorylated it is likely that this class of enzyme is able to phosphorylate a wide range of hydroxy compounds" (id.).

7. The Examiner finds that Asano discloses the synthesis of inosine monophosphate with various bacterial and yeast types, using inosine and tetrasodium pyrophosphate decahydrate in a molar ratio of about 1 to 5 (Answer 5). Appellants do not dispute this finding.

8. The Examiner finds that Gross discloses that "ribose 5-phosphate is an intermediate in the synthesis of nucleotides, histadine [sic], and tryptophan" (Answer 5). Appellants do not dispute this finding.

Principles of Law

"Obviousness does not require absolute predictability of success.... For obviousness under § 103, all that is required is a reasonable expectation of success." *In re O'Farrell*, 853 F.2d 894, 903-04 (Fed. Cir. 1988).

Analysis

Claim 1 is directed to a process for producing a pentose-5-phosphate ester by reacting ribose, arabinose or 2-deoxyribose with a phosphoric acid donor in the presence of an acid phosphatase from Shigella flexneri.

Tanaka discloses that an acid phosphatase from Shigella flexneri (PhoN-Sf) phosphorylates glucose to G6P and inosine to inosine-5'-monophosphate. Tanaka also discloses that it is likely that nonspecific acid phosphatases such as PhoN-Sf are able to phosphorylate a wide range of hydroxy compounds. We agree with the Examiner that it would have been obvious to produce ribose-5-phosphate by reacting ribose with a phosphoric acid donor in the presence of Tanaka's Shigella flexneri acid phosphatase because Tanaka discloses that the Shigella flexneri acid phosphatase is likely to phosphorylate a wide range of hydroxy compounds and Gross discloses that the resulting product is useful in making nucleotides and amino acids.

Appellants argue that nothing in the cited references guides "one of ordinary skill in the art towards using the claimed enzyme with the claimed

substrates, as opposed to the countless numbers of other potential candidate substrates" (Appeal Br. 4).

This argument is not persuasive. Gross discloses that ribose-5-phosphate is a useful intermediate and Tanaka discloses an enzymatic method for the phosphorylation of the ribose component of inosine using a Shigella flexneri acid phosphatase. Tanaka also discloses that the acid phosphatase is likely able to phosphorylate a wide range of hydroxyl substrates. Thus, phosphorylating ribose with the Shigella flexneri acid phosphatase would have been obvious in view of Tanaka and Gross because of the structural similarity between free ribose and the ribose component of inosine.

Appellants argue that one of ordinary skill in the art would not have reasonably expected that Tanaka's Shigella flexneri acid phosphatase would phosphorylate one of the pentose substrates recited in the claims (Appeal Br. 5-6). Appellants argue that the "record is full of evidence that the substrate specificity of the claimed enzyme cannot be predicted," even with compounds that have apparent structural similarity (id. at 4-5).

This argument is not persuasive. Tanaka discloses that its Shigella flexneri acid phosphatase acts on ribose when it is part of an inosine molecule, and on free glucose. Tanaka also discloses that its Shigella flexneri acid phosphatase is a nonspecific acid phosphatase (FF 3) that is likely to act on "a wide range of hydroxy compounds" (FF 6). These disclosures support a reasonable expectation that Tanaka's enzyme would phosphorylate free ribose, particularly since the phosphorylation of free glucose shows that the hypoxanthine component of inosine is not required

for the enzyme to recognize its substrate. Further, in accord with In re *O'Farrell*, a conclusion of obviousness does not require an absolute probability of success, but only requires a reasonable expectation of success, which is provided by the cited references.

Conclusion of Law

The evidence of record supports the Examiner's conclusion that one of ordinary skill in the art, based on the cited references, would have reasonably expected a Shigella flexneri acid phosphatase to phosphorylate one of the recited pentose substrates.

SUMMARY

We affirm the rejection of claims 1, 4 and 6 under 35 U.S.C. § 103(a).

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

cdc